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## (54) Antenna unit

(57) The invention relates to an antenna unit (1) for receiving electromagnetic signals in a vehicle (2), comprising a plurality of antennae (12, 17), of which at least one antenna (12) is adapted to receive signals in the GHz range and at least one antenna (17) has an essentially two-dimensional spatial extent, and two or more tuner units (20), which are each connected to at least one antenna. The antenna unit is characterized in that the output signals from the tuner units (20) are connected to a common coordinating member (22), and that said antennae, tuner units and coordinating member are arranged on a common supporting element (10) to form an integrated unit. An output signal from the coordinating member is via a communication interface (23) connectible to a vehicle-internal communication path.

Antennae and tuner units can be releasably arranged on the supporting element to provide a modularized antenna unit.

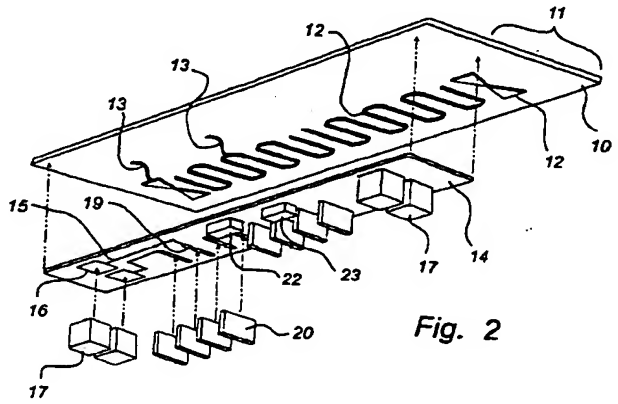


Fig. 2

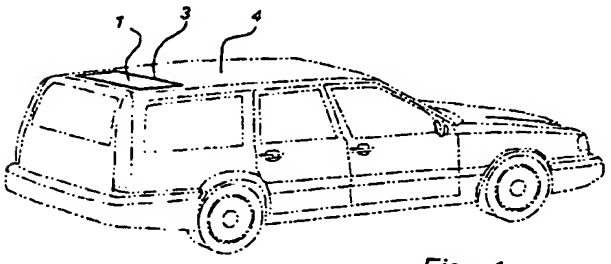


Fig. 1

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## Description

### Field of the Invention

**[0001]** The present invention relates to an antenna unit for receiving electromagnetic signals in a vehicle. The unit comprises two or more antennae and two or more tuner units, which are each connected to at least one antenna.

### Background Art

**[0002]** Concurrently with the quick development of communication techniques the need for receiving or transmitting electromagnetic signals of different types in a vehicle increases all the time. This involves, for example, analog or digital radio, analog or digital TV, mobile telephony, navigation or security information.

**[0003]** To receive these and similar signals, an increasing number of antennae are mounted in the vehicles, usually one antenna for each function. Each antenna is normally placed in a position which is suitable for the specific antenna: for example, ordinary rod antennae are fixed to the body of the vehicle, wire antennae are cast into the windowpanes, and monopole antennae in the form of plates are mounted in the bumpers of the vehicle.

**[0004]** To mount a plurality of different antennae in a vehicle a number of mounting steps are therefore necessary, which is both time-consuming and expensive.

**[0005]** When antennae are mounted in windowpanes, there is a conflict between on the one hand the effect of the glass on the receiving properties of the antenna and, on the other hand, the climate-protecting properties of the glass. There may be, for example, limitations as to the thickness of the glass owing to a radio antenna being cast into the windowpane.

**[0006]** Moreover, each antenna is connected to the receiver in question, (tuner), by means of e.g. a coaxial cable. This causes the inconvenience that the signal quality decreases when the distance is too great. To remedy this inconvenience, antenna boosters are arranged along the extent of the coaxial cable, but this is complicated and makes the installation expensive and does not 100% remedy the inconvenience.

**[0007]** In order to avoid long cables between antenna and tuner, tuners can be arranged in direct connection with the antenna. However, there is still the inconvenience of antennae which are arranged in various positions in the vehicle.

**[0008]** A problem is also that the signal requirements change all the time, depending on in which part of the world the vehicle is used and on the needs of the individual driver/passenger. With prior-art technique it is relatively complicated to install an extra antenna for e.g. GPS navigation in an existing vehicle since modifications are necessary both to mount the antenna and to connect it by means of a cable to the tuner which may be arranged at the other end of the vehicle.

**[0009]** For antennae that are mounted in the windowpanes of the vehicle the need for an additional antenna may cause a change of windowpane.

### Objects of the Invention

**[0010]** A first object of the present invention is to solve the above problems and enable a joint assembly of several antennae and tuners.

**[0011]** A second object of the invention is to eliminate the need for long coaxial cables for connecting antennae and tuners and thus eliminate the need for antenna boosters.

**[0012]** A third object of the invention is to provide a cost-efficient mounting of antennae when a large number of antennae is required.

### Summary of the Invention

**[0013]** According to the present invention these objects are achieved by an antenna unit of the type stated by way of introduction, which is characterized in that the output signals from said tuner units are connected to a common coordinating means, said antennae, tuner units and coordinating means are arranged on a common supporting element to form an integrated unit, an output signal from the coordinating means via a communication interface being connectible to a vehicle-internal communication path.

**[0014]** Several antennae can thus be arranged on a common supporting element which is then mounted in the vehicle. By arranging the receivers (tuners) in connection with the antennae on the same supporting element, the need for long lines between antenna and tuner is eliminated. At the same time the mounting of antennae and tuners is further simplified. By the output signals from several tuners being multiplexed by a coordinating means, a multiplexed signal can be made available on the internal communication path of the vehicle. When the antenna unit has been mounted in the vehicle, only a connection to the communication path is thus required for a plurality of received signals to be available all over the vehicle.

**[0015]** The communication path is suitably in prior-art manner a databus, which may comprise, for example, an optical cable.

**[0016]** An antenna can be connected to several tuners, and a tuner may be connected to several antennae. The connection which is most convenient is determined by the properties of the antennae and the signals which are to be received.

**[0017]** According to a preferred embodiment, antennae and tuner units are releasably arranged on the supporting element. This facilitates mounting and replacement of antennae and tuner units while at the same time adaptation of the antenna module to different markets will be facilitated.

**[0018]** Each antenna and each tuner which is arranged on the printed circuit board can thus be removed or changed in one simple operation. A vehicle which on delivery is not equipped with an antenna for receiving a signal of a certain kind can in a simple operation be provided with this antenna and the corresponding tuner. Thus the signal is made available on the internal databus of the vehicle and can be fetched in a suitable position, for example where equipment for the signal at issue is mounted.

**[0019]** In particular this modularized antenna unit is suitable when each antenna is relatively expensive, which is the case for e.g. GPS antennae and satellite radio antennae.

**[0020]** Since many antenna categories, such as radio or TV antennae, require a relatively great extent in at least two dimensions, antennae of this type are suitably fixedly arranged on the supporting element.

**[0021]** According to a preferred embodiment, the supporting element comprises a planar sheet of a non-conductive material, for example plastic, in order to interfere as little as possible with the reception. The sheet can be mountable in the plane of the body on the upper side of the vehicle. This arrangement of the antenna unit is advantageous owing to its great distance to the roadway as well as to the engine, both of which may cause interference in the reception. By this embodiment of the invention, an excellent or better alternative to arranging antennae in the windowpanes of the vehicle is provided.

**[0022]** If the body of the vehicle is made of a conductive material, the antenna unit is suitably mountable in a recess in the body. This prevents capacitance from arising between antennae and the conductive vehicle body.

## Brief Description of the Drawings

**[0023]** The present invention will now be described in more detail with reference to the accompanying drawings, which for the purpose of exemplification illustrate preferred embodiments of the invention.

Fig. 1 shows an antenna unit according to the invention mounted in a station wagon.

Fig. 2 is an exploded view of the antenna unit in Fig. 1.

Fig. 3 is a schematic wiring diagram of the antenna unit in Fig. 2.

Fig. 4 is a cross-sectional view of part of the vehicle in Fig.1.

## Description of a Preferred Embodiment

**[0024]** Fig. 1 shows how a preferred embodiment of an antenna unit 1 according to the invention is mounted at the rear end of the roof of a station wagon 2. In this case a recess 3 is formed in the body 4 and the antenna unit 1 is mounted in the same.

**[0025]** The antenna unit 1 is fixed in the recess 3 by an adhesive 5 (see Fig. 4), e.g. polyurethane adhesive, being applied along the joints.

**[0026]** Particularly if the body 4 is made of a conductive material such as metal sheet, it is necessary that a recess 3 be formed in the body to prevent capacitance from arising between the body and antennae in the antenna unit. If the body 4 is instead made of a non-conductive material, such as plastic or fiber material, it is not necessary to have a recess. The antenna unit can then be mounted from below, directly on the inside of the body 3.

**[0027]** In the shown example the recess 3 is essentially of the same width as the entire vehicle, and approximately one third of its length. In front of and behind the recess the body is provided with reinforcing means 6 (see Fig. 4) so as not to deteriorate the stability properties of the vehicle.

**[0028]** With reference to Fig. 2, the antenna unit 1 comprises a supporting element 10, preferably in the form of a sheet of a suitable non-conductive material, such as plastic, of the same size and shape as the recess 3.

**[0029]** In an area 11 of the underside of the supporting element 10 a plurality of antennae 12 are arranged, preferably fixedly arranged, for example by means of an adhesive or by being cast into the supporting element 10. The antennae 12 arranged in this area 11 thus have an essentially two-dimensional extent in the plane of the supporting element and they are in the first place monopole and dipole antennae which can have an arbitrary curvature in the plane defined by the supporting element 10. Examples of suitable antennae are wire antennae and foil antennae.

**[0030]** The antennae 12 operate in a known manner for receiving electromagnetic waves, preferably in frequency ranges from in the order of 100 kHz up to the order of 1 GHz. According to an embodiment of the invention antennae for radio signals (FM and AM), TV signals, ground based DAB (Digital Audio Broadcast) and signals for navigation and information systems, e.g. Traffic Message Channel (TMC), Vehicle Information Control System (VICS) and Road and Traffic Information (RTI) are arranged in this manner on the supporting element.

**[0031]** A coupling element 14 with line paths 15 formed thereon, which preferably is significantly smaller than the supporting element, is arranged on the supporting element at the side of the antennae, and with lines 13 connected to these. In the example illustrated, the coupling element is a printed circuit board 14, which covers the entire width of the supporting element but only about one fourth of its length.

**[0032]** Means 16 are arranged on the printed circuit board 14 for releasably arranging a plurality, in the shown example four, additional antennae 17 on the printed circuit board 14. Each means 16 comprises fix-

ing means for fixedly arranging the antenna 17 on the printed circuit board 14, and contact means for connecting the antenna 17 to the line paths 15 formed on the printed circuit board 14. Each antenna 17 is preferably cast into a protective casing which contributes to giving the antenna a format which is easy to handle, such as a rectangular parallelepiped.

**[0033]** The antennae 17 can be, for example, helix antennae or patch antennae and are preferably adapted to receive or transmit signals in the GHz range, i.e. electromagnetic waves in frequency ranges in the order of 1 GHz and upwards. Examples of such signals are GSM, GPS, satellite DAB and satellite telephone.

**[0034]** Moreover means 19 are arranged on the printed circuit board 14 for releasably arranging a plurality of tuner units 20 on the printed circuit board 14. Like the means 16 for arranging the antennae, these means 19 comprise fixing means for fixedly arranging the tuner unit 20 on the printed circuit board 14 and contact means for connecting the tuner unit 20 to the line paths 15 formed on the printed circuit board 14.

**[0035]** Moreover, a coordinating means, for example a multiplexor 22, is arranged on the printed circuit board to multiplex a plurality of input signals to an output signal, and a communication interface 23, which operates as an interface with a vehicle-internal communication path, preferably in the form of a databus running around the vehicle in a loop 25 which may consist of e.g. a conductive metal cable or an optical cable.

**[0036]** The parts included in the antenna unit are electrically interconnected in the manner as shown in Fig. 3. The connections are accomplished by means of the line paths 15 on the printed circuit board 14 and the lines 13 between the antennae 12 and the printed circuit board 14.

**[0037]** Each tuner unit 20 is connected to at least one of the antennae 12, 17. Particularly regarding the radio tuner it may be convenient to connect it to two of the antennae 12 for improved reception.

**[0038]** The contact means connecting each tuner unit 20 to the printer circuit board 14 may contain connection of the input signals operating voltage 30, earth 31, antenna signal 32 and the output signal 33 from the tuner unit 20. Each tuner unit 20 comprises in addition to a tuner, if appropriate, an AD converter (not shown). The tuner itself works digitally (for example GSM tuner), or the output signal from an analog tuner, for example radio tuner, is AD converted so that the output signal 33 from each tuner unit 20 is digital. It goes without saying that the AD converter could be fixedly mounted on the printed circuit board and merely the tuner could be releasable. However this requires that the output signal of the tuner be analog, which may cause a restriction.

**[0039]** The output signals 33 are connected to the multiplexor 22 where they are multiplexed to a common signal 34. This signal is received by the communication interface 23 which communicates with the databus 25. The signal processing in the entire antenna unit 1, from antenna 12, 17, via tuner unit 20 and multiplexor 22, to the communication interface 23 with the databus 25, can be accomplished with prior-art technique by a person skilled in the art.

**[0040]** According to an embodiment of the antenna unit 1 according to the invention, at least one antenna 17' which transmits and receives GSM signals is not connected to a tuner arranged on the printed circuit board. It is instead, via a line 35, for instance a coaxial cable, connected to a telephone (not shown) adjacent to the driver's seat. The reason for this solution is that the mobile telephone system is included in the safety system of the vehicle and therefore should not be dependent on the databus.

**[0041]** The printer circuit board 14 is, as is evident from Fig. 4, covered underneath with a preferably foldable flap 40 to make it easy to reach the printed circuit board from the trunk 41 of the vehicle. Locking means (not shown) of various kinds can, of course, be arranged in connection with the flap to prevent unauthorized people from having access, intentionally or unintentionally, to the components 17, 20, 22, 23 arranged on the printed circuit board 14.

**[0042]** It will be appreciated that the above preferred embodiments of the present invention are to be considered as examples only and that several variants are feasible within the scope of the inventive idea as defined in the appended claims.

**[0043]** For instance, the number and type of components, such as antennae and tuners, may be varied. The antenna unit may also comprise transmitters, which in the same way as the receivers are arranged on the printed circuit board and at least one antenna.

**[0044]** The vehicle can be of arbitrary model and category and need not necessarily be a station wagon as shown in the above description.

## Claims

1. An antenna unit (1) for receiving electromagnetic signals in a vehicle (2), comprising two or more antennae (12, 17) and two or more tuner units (20), which are each connected to at least one antenna (12, 17), **characterized** in that

   the output signals (33) from said tuner units are connected to a common coordinating means (22),
   said antennae, tuner units and coordinating means are arranged on a common supporting element (10) to form an integrated unit,
   an output signal (34) from the coordinating means (22) via a communication interface (23) being connectible to a vehicle-internal communication path (25).

2. An antenna unit as claimed in claim 1, wherein at least one of the antennae (17) is adapted to receive

signals in the GHz range.

3. An antenna unit as claimed in claim 1 or 2, wherein at least one of the antennae (12) has an essentially two-dimensional spatial extent.

4. An antenna unit as claimed in any one of the preceding claims, wherein at least one antenna (17) is adapted to be releasably arranged on the supporting element (10).

5. An antenna unit as claimed in any one of the preceding claims, wherein at least one tuner unit (20) is adapted to be releasably arranged on the supporting element (10).

6. An antenna unit as claimed in any one of the preceding claims, wherein at least one antenna (12) is fixedly arranged on the surface of the supporting element (10).

7. An antenna unit as claimed in any one of the preceding claims, wherein the supporting element (10) comprises an essentially planar sheet of a non-conductive material, such as plastic, which is adapted to be mountable in the plane of the body (4) on the upper side of the vehicle (2).

8. An antenna unit as claimed in any one of the preceding claims, which, when the body (4) of the vehicle is made of a conductive material, is mountable in a recess (3) in the body of the vehicle.

9. An antenna unit as claimed in any one of the preceding claims, wherein at least one antenna (12, 17) is connected to two or more tuner units (20).

10. An antenna unit as claimed in any one of the preceding claims, wherein the coordinating means comprises a multiplexor (22).

11. An antenna unit as claimed in any one of the preceding claims, wherein the communication path (25) comprises a databus.

12. An antenna unit as claimed in any one of the preceding claims, wherein the communication path (25) comprises an optical cable.

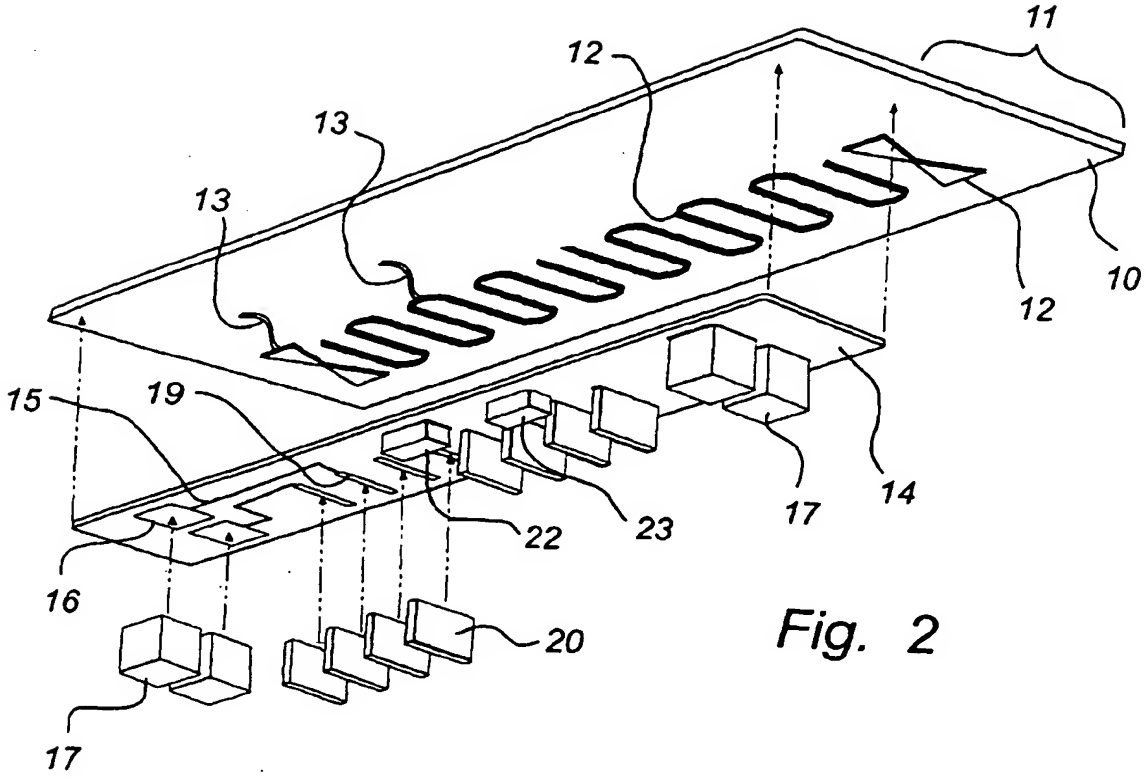


Fig. 2

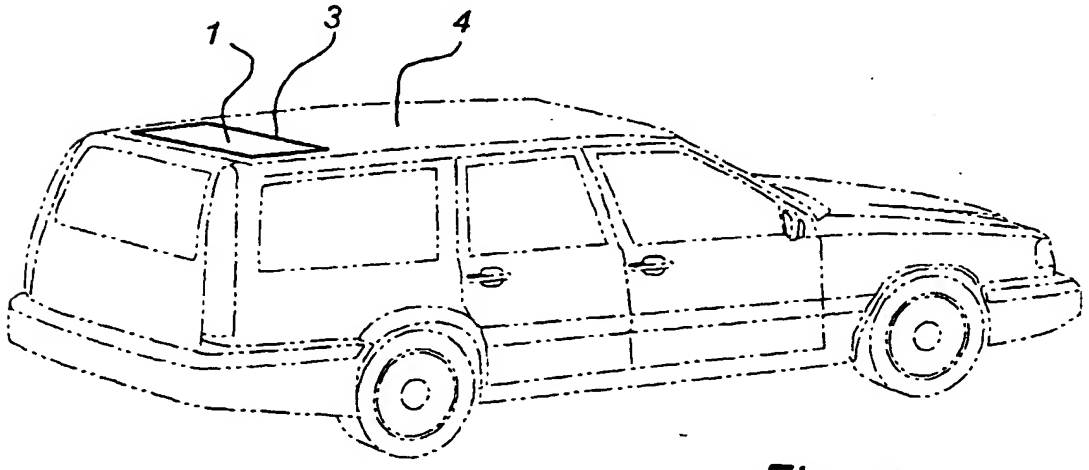


Fig. 1

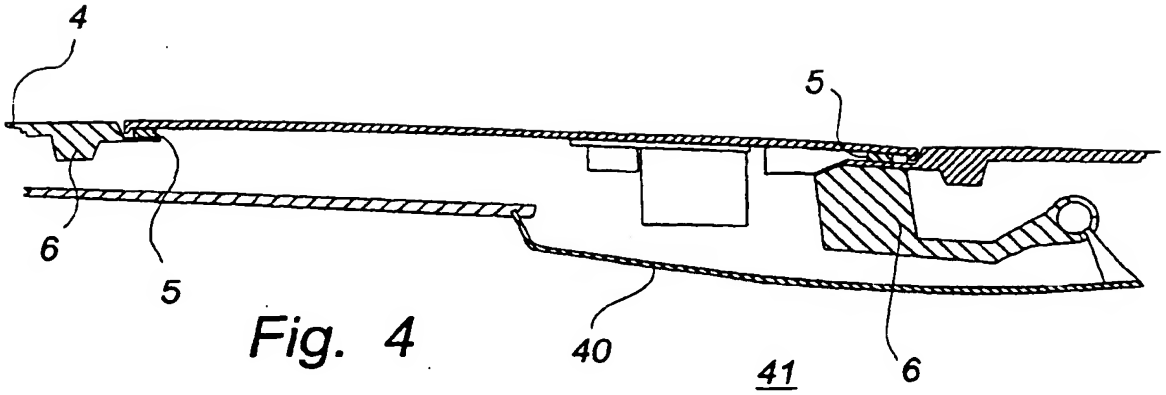


Fig. 4

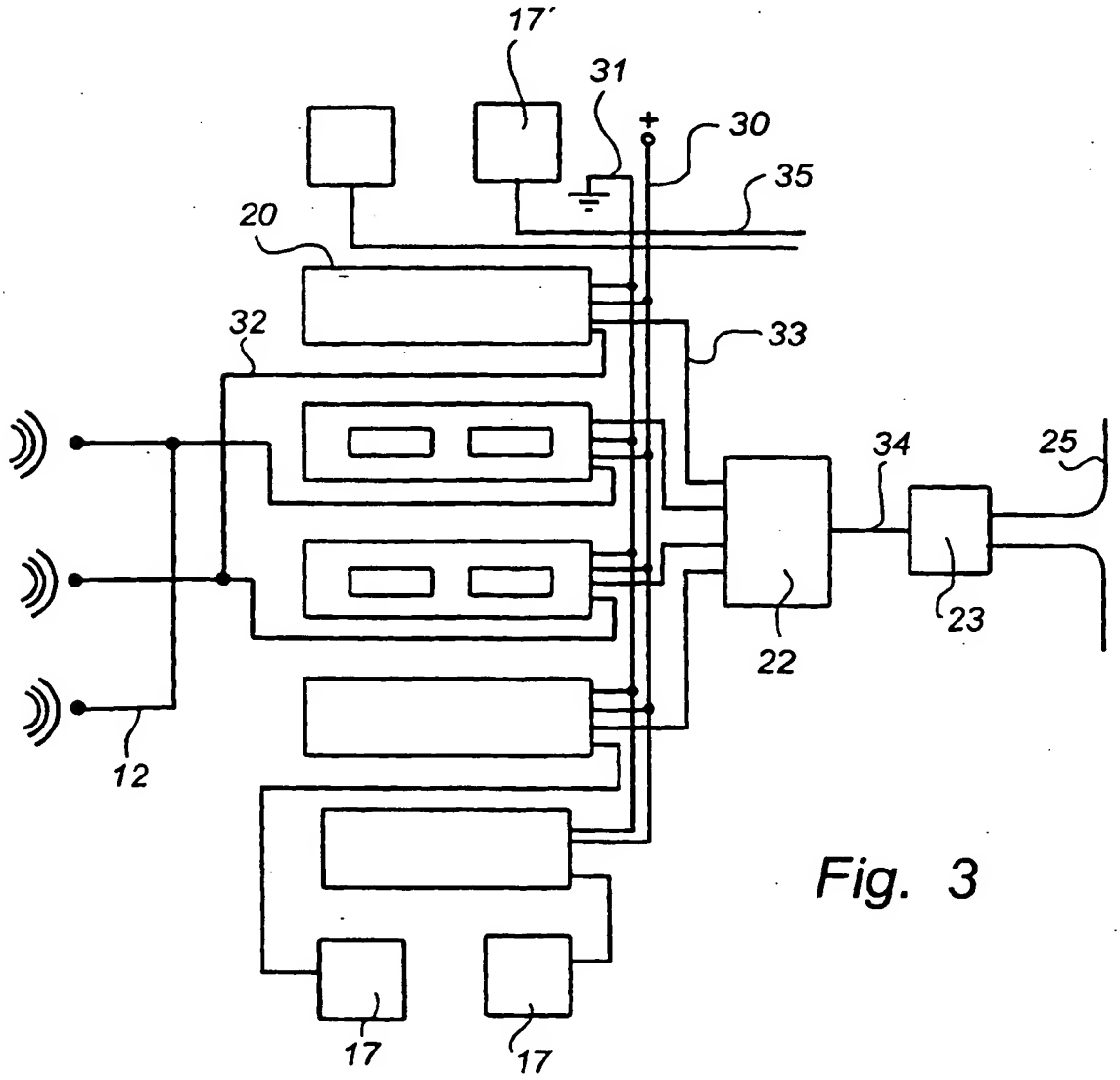


Fig. 3

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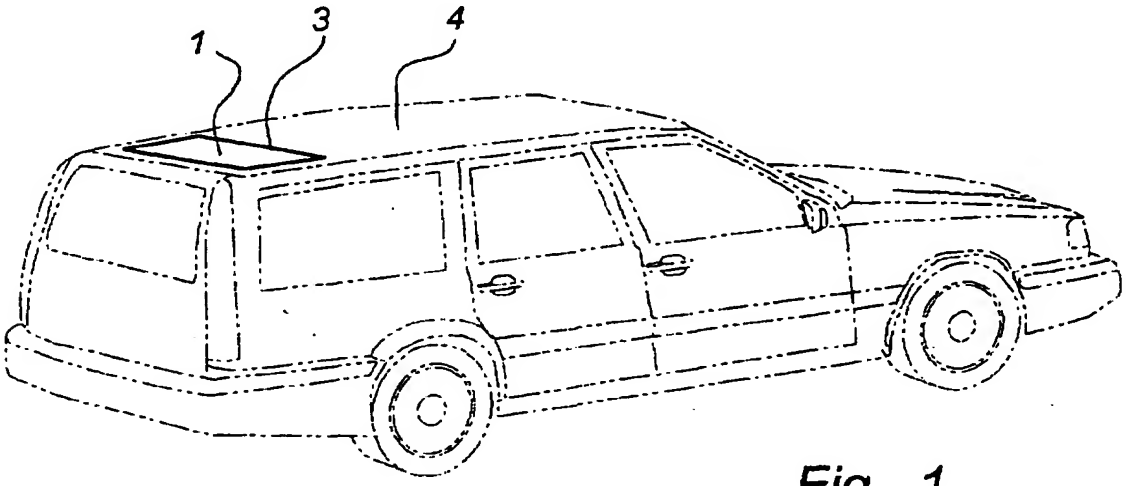


Fig. 1

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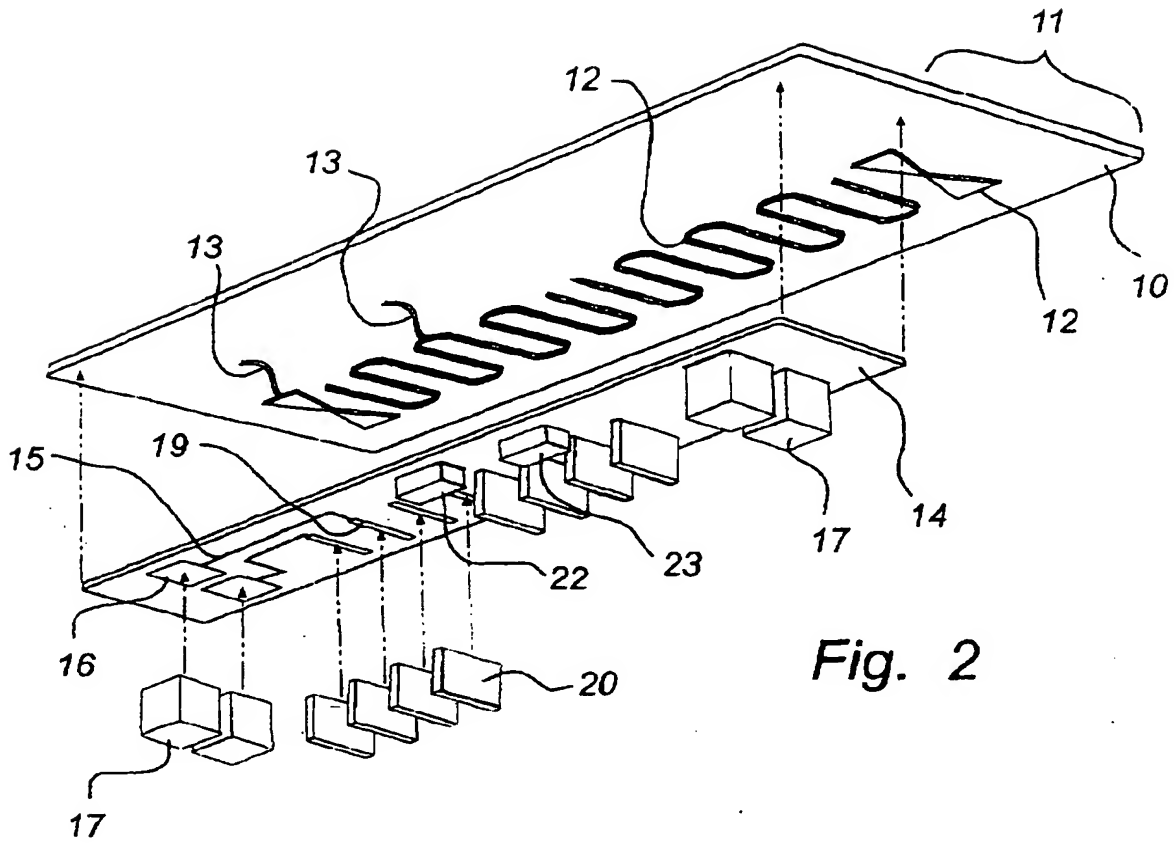


Fig. 2

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Application Number
EP 00 12 0369

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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01Q

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 16 August 2002 | Van Dooren, G |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 12 0369

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16-08-2002

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